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WOODCOCK LAKE, KANDIYOHI COUNTY, MINNESOTA

Pacific Northwest Environmental Research Laboratory

Prepared for:

National Envieonmental Research Center
National Environmental Research Center
Minnesota Pollution Control Agency
Minnesota National Guard

July 1975

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NATIONAL EUTROPHICATION SURVEY

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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Report
on
Woodcock Lake
Kandiyohi County
Minnesota
EPA Region V
Working Paper No. 141

With the cooperation of the
Minnesota Pollution Control Agency
and the
Minnesota National Guard

July, 1975

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CONTENTS

	Page
Foreword	ii
List of Minnesota Study Lakes	iv, v
Lake and Drainage Area Map	vi
Sections	
I. Introduction	1
II. Conclusions	1
III. Lake Characteristics	3
IV. Lake Water Quality Summary	4
V. Literature Reviewed	7
VI. Appendices	8

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS*

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

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* The lake discussed in this report was included in the National Eutrophication Survey as a water body of interest to the Minnesota Pollution Control Agency. Tributaries were not sampled, and this report relates only to the data obtained from lake sampling.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Minnesota Pollution Control Agency for professional involvement and to the Minnesota National Guard for conducting the tributary sampling phase of the Survey.

Grant J. Merritt, Director of the Minnesota Pollution Control Agency, John F. McGuire, Chief, and Joel G. Schilling, Biologist, of the Section of Surface and Groundwater, Division of Water Quality, provided invaluable lake documentation and counsel during the course of the Survey; and the staff of the Section of Municipal Works, Division of Water Quality, were most helpful in identifying point sources and soliciting municipal participation in the Survey.

Major General Chester J. Moeglein, the Adjutant General of Minnesota, and Project Officer Major Adrian Beltrand, who directed the volunteer efforts of the Minnesota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

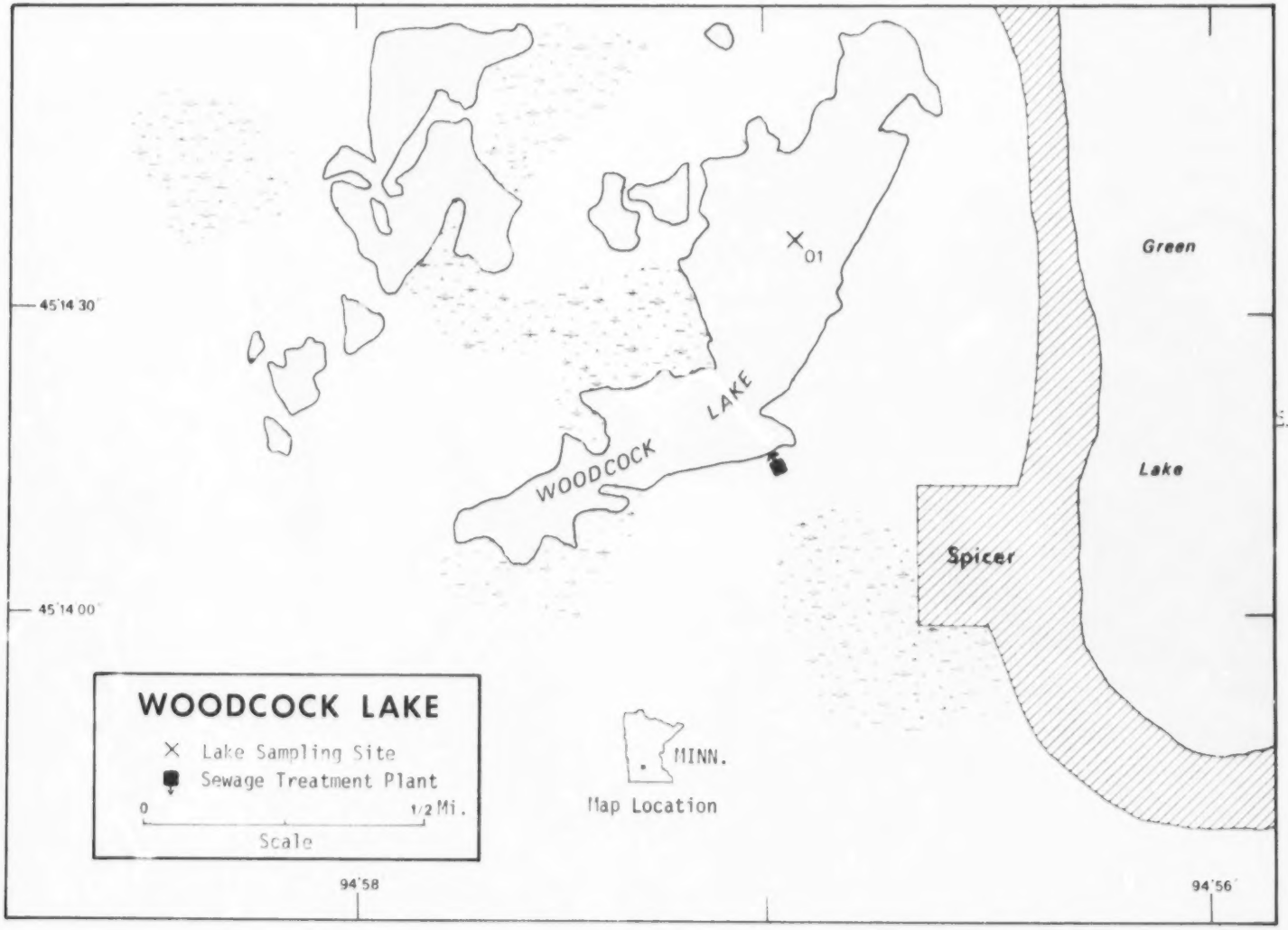
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MINNESOTA

LAKE NAME	COUNTY
Albert Lea	Freeborn
Andrusia	Beltrami
Badger	Polk
Bartlett	Koochiching
Bear	Freeborn
Bemidji	Beltrami
Big	Stearns
Big Stone	Big Stone, MN; Roberts, Grant, SD
Birch	Cass
Blackduck	Beltrami
Blackhoof	Crow Wing
Budd	Martin
Buffalo	Wright
Calhoun	Hennepin
Carlos	Douglas
Carrigan	Wright
Cass	Beltrami, Cass
Clearwater	Wright, Stearns
Cokato	Wright
Cranberry	Crow Wing
Darling	Douglas
Elbow	St. Louis
Embarass	St. Louis
Fall	Lake
Forest	Washington
Green	Kandiyohi
Gull	Cass
Heron	Jackson
Leech	Cass
Le Homme Dieu	Douglas
Lily	Blue Earth
Little	Grant
Lost	St. Louis

LAKE NAME	COUNTY
Madison	Blue Earth
Malmedal	Pope
Mashkenode	St. Louis
McQuade	St. Louis
Minnetonka	Hennepin
Minnewaska	Pope
Mud	Itasca
Nest	Kandiyohi
Pelican	St. Louis
Pepin	Goodhue, Wabasha, MN; Pierce, Pepin, WI
Rabbit	Crow Wing
Sakatah	Le Sueur
Shagawa	St. Louis
Silver	McLeod
Six Mile	St. Louis
Spring	Washington, Dakota
St. Croix	Washington, MN; St. Croix, Pierce, WI
St. Louis Bay	St. Louis, MN; Douglas, WI
Superior Bay	St. Louis, MN; Douglas, WI
Swan	Itasca
Trace	Todd
Trout	Itasca
Wagonga	Kandiyohi
Wallmark	Chisago
White Bear	Washington
Winona	Douglas
Wolf	Beltrami, Hubbard
Woodcock	Kandiyohi
Zumbro	Olmstead, Wabasha


WOODCOCK LAKE
Lake Sampling Site
Sewage Treatment Plant
0
1/2 Mi.
Scale
MINN.
Map Location
45°14'30"
45°14'00"
94°58'
94°56'
WOODCOCK
LAKE
01
Green
Lake
Spicer

WOODCOCK LAKE

STORET NO. 27A3

I. INTRODUCTION

Woodcock Lake was included in the National Eutrophication Survey as a water body of interest to the Minnesota Pollution Control Agency. The trickling filter wastewater treatment plant serving the Village of Spicer discharges directly to the lake*, but only two effluent samples were provided for Survey analyses (Appendix B). Tributaries were not sampled, and other nutrient sources were not evaluated. Therefore, this report relates only to the lake sampling data.

II. CONCLUSIONS

A. Trophic Condition:

Survey data indicate Woodcock Lake is hypereutrophic. Of the 60 Minnesota lakes sampled in the fall when essentially all were well-mixed, 53 had less mean total phosphorus, 53 had less mean dissolved phosphorus, and 45 had less mean inorganic nitrogen. Of the 80 Minnesota lakes sampled, 66 had less mean chlorophyll a, and 62 had greater mean Secchi disc transparency. Dissolved oxygen was nearly depleted at 10 feet in July and August, 1972.

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* Anonymous, 1974.

Survey limnologists noted the lake was very turbid and observed algal blooms in progress on all sampling occasions with a very heavy bloom in August. Blue-green algae were dominant in all phytoplankton samples.

B. Rate-Limiting Nutrient:

A 25% loss of dissolved phosphorus and a 22% gain of inorganic nitrogen occurred in the algal assay sample between the time of collection and the beginning of the assay, and the results are not representative of conditions in the lake at the time the sample was taken (10/25/72).

The lake data indicate nitrogen limitation at all sampling times; i.e., N/P ratios were 1/1 or less, and nitrogen limitation would be expected.

III. LAKE CHARACTERISTICS

A. Morphometry*:

1. Surface area: 125 acres.
2. Mean depth: 2.5 feet.
3. Maximum depth: 8 feet.
4. Volume: 312 acre-feet.

B. Precipitation**:

1. Year of sampling: 27.0 inches.
2. Mean annual: 24.5 inches.

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* MN Dept. of Conservation waterfowl and muskrat habitat survey map (1952).
** See Working Paper No. 1, "Survey Methods, 1972".

IV. LAKE WATER QUALITY SUMMARY

Woodcock Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at a single station on the lake (see map, page vi). During each visit, a single depth-integrated (near bottom to surface) sample was collected for phytoplankton identification and enumeration, and a similar sample was collected for chlorophyll a analysis. During the last visit, a single five-gallon depth-integrated sample was taken for algal assays. The maximum depth sampled was 11 feet.

The results obtained are presented in full in Appendix A, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized in the following table. Note, however the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix A.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (10/25/72)		
Temperature (Cent.)	5.3	5.3	5.3	5.4
Dissolved oxygen (mg/l)	9.3	11.4	11.4	13.6
Conductivity (μmhos)	490	493	490	500
pH (units)	9.1	9.1	9.1	9.1
Alkalinity (mg/l)	220	230	230	240
Total P (mg/l)	0.830	0.903	0.870	1.010
Dissolved P (mg/l)	0.670	0.677	0.680	0.680
$NO_2 + NO_3$ (mg/l)	0.290	0.293	0.290	0.300
Ammonia (mg/l)	0.390	0.403	0.390	0.430
		ALL VALUES		
Secchi disc (inches)	12	15	14	18

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
07/02/72	1. Microcystis	16,396
	2. Merismopedia	8,198
	3. Cyclotella	5,766
	4. Scenedesmus	3,243
	5. Anabaena	991
	Other genera	2,793
	Total	37,387
08/31/72	1. Aphanocapsa	30,374
	2. Microcystis	21,334
	3. Merismopedia	13,018
	4. Lyngbya	4,339
	5. Anabaena	1,446
	Other genera	2,893
	Total	73,404
10/25/72	1. Anabaena	4,586
	2. Chroococcus	3,834
	3. Dinobryon	2,481
	4. Merismopedia	2,481
	5. Cyclindrocystis	2,256
	Other genera	6,994
	Total	22,632

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (μg/l)
07/02/72	01	54.3
08/31/72	01	56.5
10/25/72	01	115.5

V. LITERATURE REVIEWED

Anonymous, 1974. Wastewater disposal facilities inventory. MPCA, Minneapolis.

VI. APPENDICES

APPENDIX A

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/12/10

27A301
45 14 36.0 094 56 57.0
WOODCOCK LAKE
27 MINNESOTA

11FWALES 2111202
3 0010 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CONDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/02	00 00	0000	22.0	7.2	14	460	8.90	238	0.160	0.210	0.848	0.720
	00 00	0010	20.0	7.6		750	8.90	264	0.040	0.640	1.030	0.512
72/08/31	14 40	1300			12	470	9.05	238	0.160	0.220	1.040	0.650
	14 40	0000	20.5	5.4		450	9.10	242	0.250	0.220	1.000	0.625
	14 40	0007	20.3	5.0		465	9.05	244	0.190	0.020	0.965	0.565
	14 40	0011	20.1	2.6		470	9.00	235	0.220	0.330	1.020	0.680
72/10/25	14 20	0000			18	500	9.10	240	0.300	0.390	0.870	0.670
	14 20	0004	5.4	9.3		490	9.10	220	0.290	0.390	0.830	0.680
	14 20	0011	5.3	13.6		490	9.10	230	0.290	0.430	1.010	0.680

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLOROPHYL A UG/L
72/07/02	00 00	0000	54.30
72/08/31	14 40	0000	56.30
72/10/25	14 20	0000	115.30

J VALUE KNOWN TO BE IN ERROR

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APPENDIX B

WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 74/10/10

27A351 TF27A351 P000586
45 14 00.0 094 57 00.0
SPICER
27 15 ATWATER
O/WOODCOCK LAKE
WOODCOCK LAKE
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/02/09	13 30								
CP(T)-			1.600	10.000	1.260	2.600	3.800	0.075	
73/02/09	13 30								
73/07/26	13 30								
CP(T)-			5.660	21.000	4.500	5.400	7.200		
73/07/26	13 30								